

COUNTRY ANALYSIS BRIEFS

Brazil

Last Updated: September 2009

Background

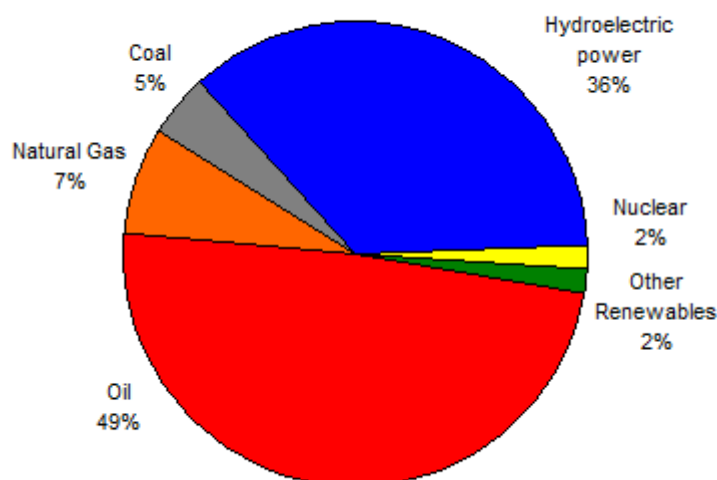
Brazil has experienced rapidly expanding oil, natural gas, and electricity consumption in recent years.

Brazil is the 10th largest energy consumer in the world and the 3rd largest in the Western Hemisphere, behind the United States and Canada. Total primary energy consumption in Brazil has increased significantly in recent years, due to sustained economic growth. In addition, Brazil has made great strides in increasing its total energy production, particularly oil, over the past decade. Increasing domestic oil production has been a long-term goal of the Brazilian government, and recent discoveries of large offshore, pre-salt oil deposits could transform Brazil into one of the largest oil producers in the world.



The largest share of Brazil's total energy consumption comes from oil (49 percent, including ethanol), followed by hydroelectricity (36 percent) and natural gas (7 percent). The large share of hydroelectricity in Brazil's energy mix represents the dependence of electricity generation on hydroelectric dams. Natural gas is currently a small share of total energy consumption, but attempts to diversify electricity generation from hydropower to gas-fired power plants should cause natural gas consumption to grow in coming years.

Total Energy Consumption in Brazil, by Type (2006)



Source: EIA International Energy Annual 2006

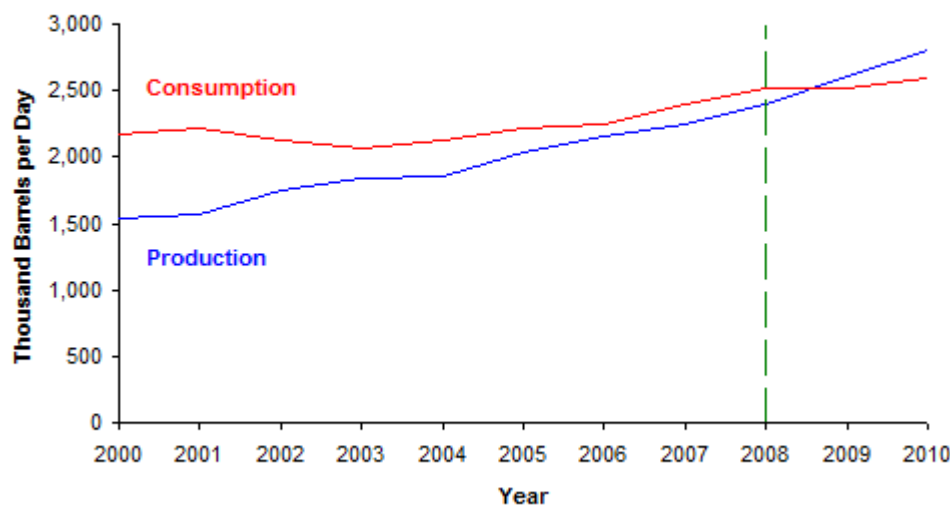
Oil

Overview

The largest oil discoveries in recent years have come from Brazil's offshore, pre-salt basins.

According to the *Oil and Gas Journal (OGJ)*, Brazil had 12.6 billion barrels of proven oil reserves in 2009, second-largest in South America after Venezuela. The offshore Campos and Santos Basins, located on the country's southeast coast, contain the vast majority of Brazil's proven reserves. In 2008, Brazil produced 2.4 million barrels per day (bbl/d) of oil, of which 76 percent was crude oil. Brazil's oil production has risen steadily in recent years, with the country's oil production in 2008 about 150,000 bbl/d (6 percent) higher than 2007. Based on its September 2009 *Short-Term Energy Outlook*, EIA forecasts Brazilian oil production to reach 2.61 million bbl/d in 2009 and 2.81 million bbl/d in 2010. Brazil's oil consumption averaged 2.52 million bbl/d in 2008. As a result of this rising oil production and flat consumption growth, EIA expects that Brazil will become a net oil exporter in 2009.

Brazil's Oil Production and Consumption



Source: EIA Short Term Energy Outlook, September 2009.

Sector Organization

State-controlled Petrobras is the dominant player in Brazil's oil sector, holding important positions in up-, mid-, and downstream activities. The company held a monopoly on oil-related activities in

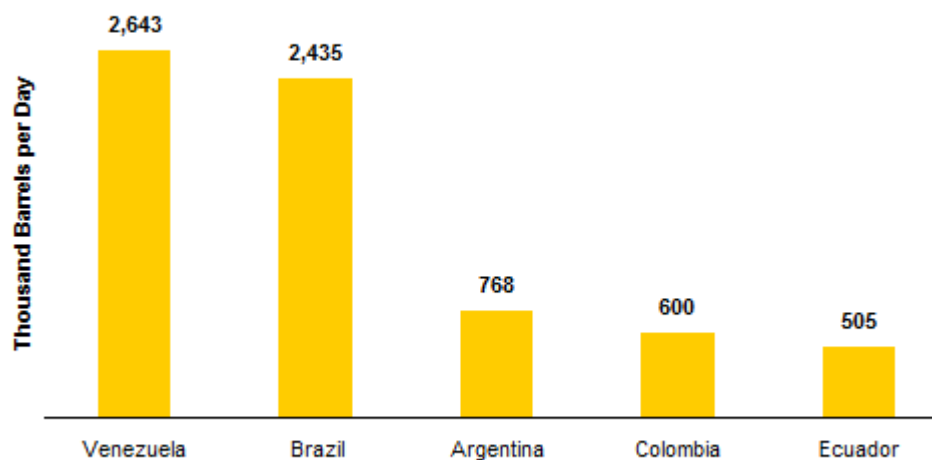
the country until 1997, when the government opened the sector to competition. The principal government agency charged with monitoring the oil sector is the National Petroleum Agency (ANP), which is responsible for issuing exploration and production licenses and ensuring compliance with relevant regulations.

Despite the opening of the sector to private actors in the late 1990s, foreign-operated oil projects are not common in Brazil and represent a small share of total oil production. Royal Dutch Shell was the first foreign operator of crude oil production in the country, and it is now joined by Chevron and Devon. Private competition in the sector is not just from foreign companies: in September 2009, Brazilian oil company OGX commenced an exploratory drilling program in the Campos Basin.

Exploration and Production

Petrobras controls almost all crude oil production in Brazil. The largest oil-production region of the country is Rio de Janeiro state, which contains over 80 percent of Brazil's total production. Most of Brazil's crude oil production is offshore in very deep water and consists of mostly-heavy grades. One of Brazil's principle marketed crude streams is Marlim, which has an API of 19.6° (heavy) but a relatively low sulfur content of 0.7 percent (sweet).

Top 5 South American Oil Producers, 2008



Source: EIA Country Energy Profiles

Petrobras has brought numerous projects onstream recently. In December 2008, Petrobras brought the P-53 floating production, storage, and offloading (FPSO) unit online in the Marlim Leste field, with a production capacity of 180,000 bbl/d. In January 2009, Petrobras deployed a second FPSO to the Marlim Sul field, P-51, also with a production capacity of 180,000 bbl/d. In March 2009, Petrobras launched the FPSO *Cidade de Niteroi* in the Jabuti field, with a production capacity of 100,000 bbl/d. Finally, in May 2009, Petrobras commenced the Tupi Extended Well Test, the first attempt to produce from the recently-discovered sub-salt reserves in the Santos Basin (see below). Along with these new projects, many units brought online in 2008 continued to ramp-up towards their peak production rates.

In large part due to this sizable slate of recent expansions, EIA expects that Brazil's total oil production could reach 2.81 million bbl/d in 2010. This forecast takes into account the above-mentioned projects and an estimate for decline rates at Brazil's older, mature fields. This could make Brazil one of the largest sources of new, non-OPEC oil supply growth. However, recent experience has shown that forecasts of non-OPEC supply growth have generally been over-optimistic, so there is considerable downside risk to this forecast. Such risks include larger decline rates at mature fields and delays to project schedules.

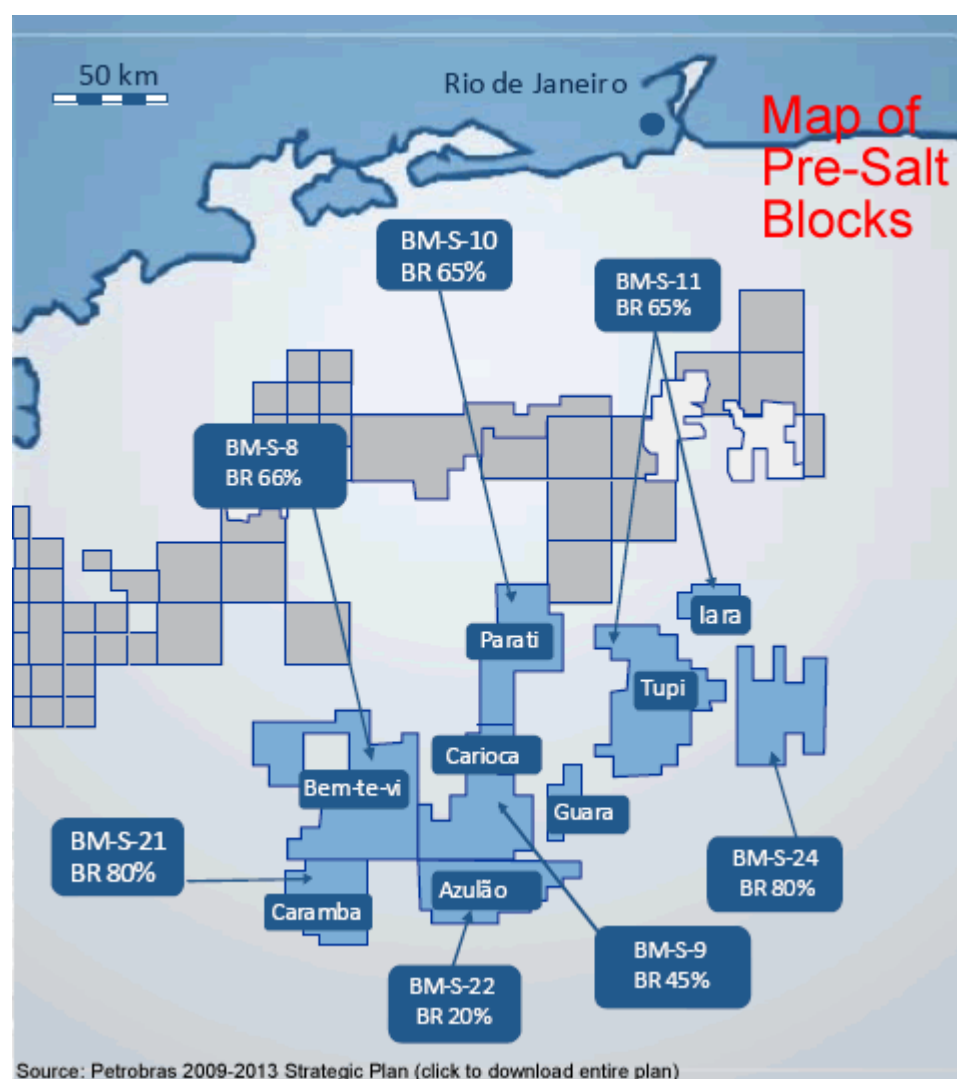
Foreign Oil Operators

Shell's Bijupira-Salema project in the Campos Basin was the first field in Brazil not operated by

Petrobras. The project came on-stream in 2003 and produces about 50,000 bbl/d. Shell launched its BC-10 project in July 2009, which has a designed capacity of 100,000 bbl/d. Devon brought its Polvo project (50,000 bbl/d) online in August 2007, representing the only upstream oil project in Brazil without any Petrobras participation. Chevron commenced operations at the Frade project (100,000 bbl/d) in July 2009. Finally, StatoilHydro is developing the Peregrino field in Brazil, with expected production capacity of 100,000 bbl/d.

Pre-Salt Resources: Tupi and Beyond

A consortium of Petrobras, BG Group, and Petrogal discovered the Tupi field in 2006, containing an estimated 5-8 billion barrels of recoverable reserves (including both oil and natural gas). The reserves occur in a subsalt zone that is an average of 18,000 feet below the ocean surface. The Tupi find was the largest oil discovery since the supergiant Kashagan field in Kazakhstan. In addition, oil encountered in the subsalt zones appears to be lighter and sweeter than most of Brazil's existing production. Following Tupi, numerous additional pre-salt discoveries were announced, such as Carioca, Iara, and Guara. Preliminary estimates by industry analysts of the total extent of recoverable oil and natural gas reserves in the entire subsalt reserve have exceeded 50 billion barrels of oil equivalent. In early 2009, Petrobras inaugurated an extended test at the Tupi field, which will produce 14,000 bbl/d and help develop techniques and expertise to overcome the challenges of pre-salt production.



Tupi and the subsequent pre-salt announcements immediately transformed the nature and focus of Brazil's oil sector, and the potential impact of the discoveries upon world oil markets is vast. However, considerable challenges must still be overcome in order to bring these reserves to fruition. The difficulty of access to the reserves, considering both the large depths and pressures

involved with subsalt oil production, mean that there are many technical hurdles that must be overcome. Production from additional pilot projects is possible in the next several years, but large-scale development of the subsalt reserves will likely not occur until well into the next decade. In 2009, Petrobras released its strategic plan for developing the pre-salt areas. This plan included development of the Tupi, Iara, and Guara fields that would occur in three discrete phases: extended well tests, pilot projects, then large-scale production through multiple, duplicate FPSOs.

Proposed Regulatory Reforms

The Brazilian government released the proposed regulatory framework for the pre-salt reserves in August 2009. The framework consists of four pieces of legislation. First, the rules would establish new production share agreements (PSAs) to exploit the pre-salt reserves, in contrast with the concession framework used for existing resources. Petrobras would be the sole operator of each PSA and would hold a minimum 30 percent stake in the projects. Second, the rules would create a new agency, Petrosal, to administer the state's share of each PSA. Third, the government would establish a new development fund to manage government revenues from the pre-salt development. The fourth piece of legislation would allow the government to capitalize Petrobras by granting it pre-salt oil reserves that are currently not otherwise licensed. These new rules would not affect existing operators in Brazil.

The proposed regulatory framework would have important implications for the development of Brazil's oil sector. The emphasis upon Petrobras as the sole operator in the pre-salt basin would surely slow the pace of development of new projects, especially considering the company's already-aggressive development plans for pre- and post-salt oil reserves. The rules would also increase the government take of profits from oil production, possibly reducing the incentive for private companies to participate. In addition, PSA structure proposed in the legislation would give non-operating partners little influence over project decisions. As of September 2009, the new regulations were still being debated, and a final form had not yet emerged.

Pipelines

Transpetro, a wholly owned subsidiary of Petrobras, operates Brazil's crude oil transport network. The system consists of 4,000 miles of crude oil pipelines, coastal import terminals, and inland storage facilities. The overall structure of the network enables the movement of crude oil from coastal production facilities and import terminals to inland refineries and consumption centers.

Downstream

According to OGJ, Brazil has 1.9 million bbl/d of crude oil refining capacity spread amongst 13 refineries. Petrobras operates 11 facilities, the largest being the 360,000-bbl/d Paulinia refinery in Sao Paulo. Petrobras also controls a dominant stake in the retail products market. The refining capacity in Brazil is relatively simple, meaning that the country must export some of its heavy crude oil production and import light crude oil: according to Petrobras, domestic crude constituted 78 percent of total domestic refinery feedstock. Gasoline prices in Brazil are relatively high when compared to international levels: according to the German Agency for Technical Cooperation (GTZ), regular unleaded gasoline prices averaged \$1.26 per liter in November 2008 (\$5.04 per gallon), versus \$2.21 per gallon in the United States.

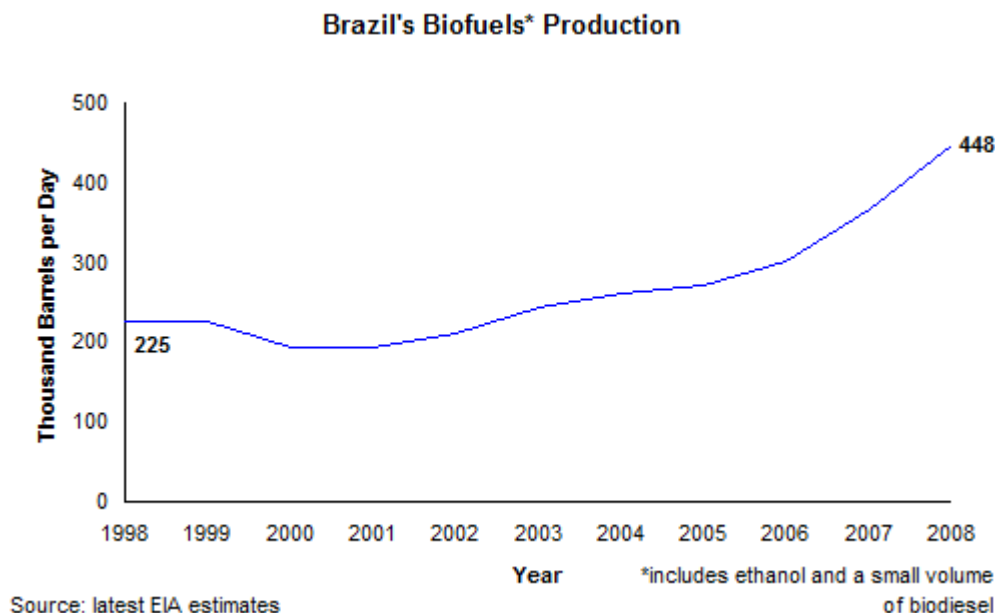
According to its strategic plan, Petrobras plans to increase its Brazilian refining capacity to 3.0 million bbl/d by 2020. In 2007, Petrobras began initial site preparation for a new, 230,000-bbl/d refinery in Pernambuco, dubbed Abreu e Lima. The project is supposed to be a joint venture with state-owned Petroleos de Venezuela S.A. (PdVSA), with each country providing half of the heavy-oil feedstock for the plant. However, the two partners have yet to conclude a final agreement. Petrobras estimated that the project would cost \$12 billion.

Ethanol

Brazil is one of the largest producers of ethanol in the world and is the largest exporter of the fuel. In 2008, Brazil produced 454,000 bbl/d of ethanol, up from 365,000 in 2007. All gasoline in Brazil contains ethanol, with blending levels varying from 20-25 percent. Over half of all cars in the country are of the flex-fuel variety, meaning that they can run on 100 percent ethanol or an ethanol-gasoline mixture. According to ANP, Brazil also produced about 20,000 bbl/d of biodiesel in 2008, and the agency has enacted a three-percent blending requirement for domestic diesel sales.

The importance of ethanol in Brazil's domestic transportation fuels market will only increase in the future. According to Petrobras, ethanol accounts for more than 50 percent of current light vehicle fuel demand, and the company expects this to increase to over 80 percent by 2020. Nearly 90

percent of all new cars sold in Brazil are flex-fuel vehicles, which will slowly remove gasoline-only cars from the fleet.



Because ethanol production continues to grow faster than domestic demand, Brazil has sought to increase ethanol exports. According to industry sources, Brazil's ethanol exports reached 86,000 bbl/d in 2008, with 13,000 bbl/d going to the United States. Brazil is the largest ethanol exporter in the world, holding over 90 percent of the global export market. Besides the United States, important export destinations include Europe and Japan: According to industry reports, Brazil exported 690 bbl/d of ethanol to Japan in 2008, but exporters were expected to increase to 1,600 bbl/d in 2009.

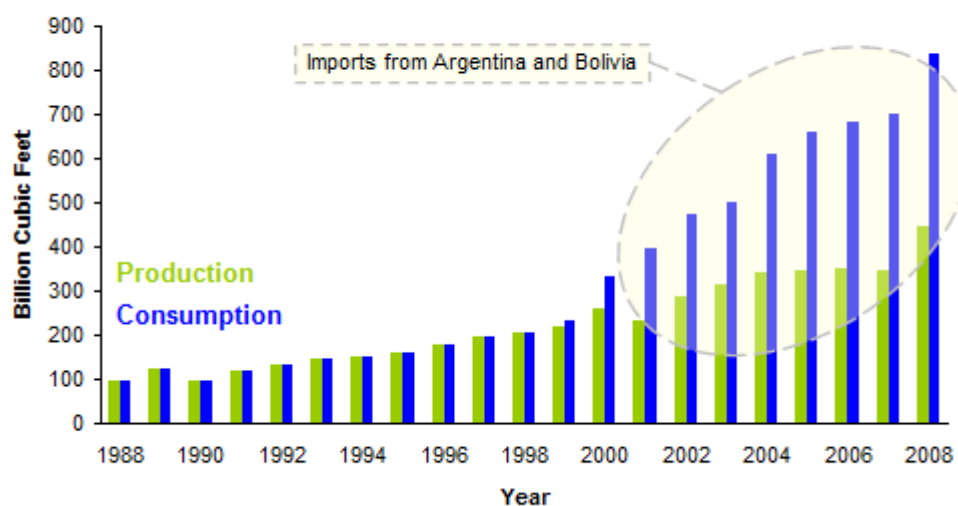
Natural Gas

Natural gas constitutes only a small portion of Brazil's total energy consumption.

OGJ reported that Brazil had 12.9 trillion cubic feet (Tcf) of proven natural gas reserves in 2009. The Campos and Santos Basins hold the majority of reserves, but there are also sizable reserves in the interior parts of the country. Despite Brazil's sizable natural gas reserves, natural gas production has grown slowly in recent years, mainly due to a lack of domestic transportation capacity and low domestic prices. In 2008, Brazil produced 466 billion cubic feet (Bcf) of natural gas, mostly unchanged from 2007.

Natural gas consumption is a small part of the country's overall energy mix, constituting only 7 percent of total energy consumption in 2006. However, natural gas demand is rising: in 2008, Brazil consumed 835 Bcf of natural gas, up from 701 Bcf in 2007. High oil prices have helped spur natural gas demand in Brazil: natural gas is mostly used as a substitute for fuel oil in industrial and power-generating applications, and domestic prices for natural gas are much lower than international fuel oil prices. The introduction of natural gas imports has increased available supplies, helping to facilitate this growth in domestic consumption.

Brazil's Natural Gas Production and Consumption



Source: EIA Country Energy Profiles

Sector Organization

Petrobras is the largest producer of natural gas in Brazil. The company reportedly controls over 90 percent of Brazil's natural gas reserves. Other important participants in the sector include Sulgas and Britain's BG. ANP has sought to attract international investment to the sector, with recent exploration licensing rounds including many gas-prone areas. Petrobras is also the largest wholesale supplier of natural gas. The industrial sector is the largest consumer of natural gas in Brazil, representing about 80 percent of total domestic consumption. However, the two fastest growing sectors are thermal electricity generation and vehicular compressed natural gas (CNG).

Exploration and Production

The largest share of Brazil's natural gas production occurs from offshore fields in the Campos Basin in Rio de Janeiro state. Most onshore production occurs in Amazonas and Bahia states and is mostly for local consumption due to the shortage of transportation infrastructure.

In order to meet rising demand, Petrobras plans to bring several new natural gas projects online over the coming years. The largest is the Mexilhao project, which contains estimated total reserves of 3 Tcf. Current plans call for production to come online in May 2010 at 100 Bcf per year, eventually rising to 190 Bcf per year.

As discussed in the Oil section of this report, recent announcements about discoveries in Brazil's offshore subsalt have generated considerable excitement. Along with their potential to significantly increase oil production in the country, the subsalt areas are estimated to contain sizable natural gas reserves as well. According to Petrobras, Tupi alone could contain 5-7 Tcf of recoverable natural gas, which if proven, could increase Brazil's total natural gas reserves by 50 percent. There are plans to build a natural gas pipeline from Tupi to Mexilhao, where the natural gas could then flow into the national grid.

Pipelines

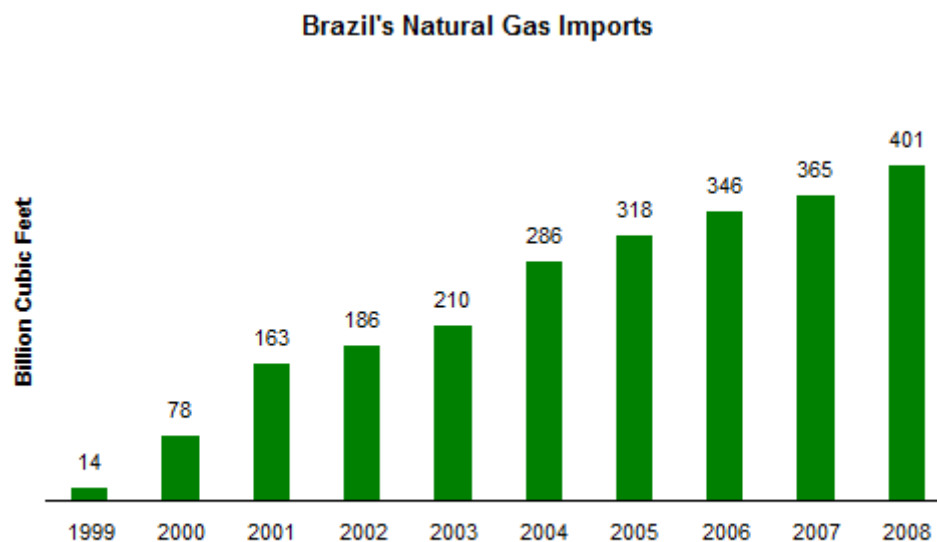
Petrobras operates Brazil's domestic natural gas transport system. The network has over 4,000 miles of natural gas pipelines, mostly in the southeast and northeast parts of the country. The network consists of main systems in the southeast, northeast, and the state of Espirito Santo; these systems are not currently interconnected, which has hindered development of domestic production and consumption. In June 2006, China's Sinopec began construction on the 730-mile Gasene pipeline linking the northeast and southeast networks. According to media reports, construction of the third and final stage of the Gasene system began in 2008, with completion of the project expected by March 2010.

A lack of natural gas transportation infrastructure has delayed exploration and production in the interior regions of the country. In particular, Amazonas state contains considerable reserves that

remain unexploited, especially the Urucu field, which contains Brazil's largest onshore natural gas reserves. In 2005, Petrobras began construction of the Urucu pipeline that will link Urucu to Manaus, the capital of Amazonas state. The project will convert an existing liquefied petroleum gas (LPG) pipeline from Urucu to Coari to carry natural gas and a new natural gas pipeline from Coari to Manaus. According to Petrobras, the project should come online by the end of 2009.

Imports

According to ANP, Brazil imported about 400 Bcf of natural gas in 2008. The country currently receives imports from three sources: Bolivia, Argentina, and liquefied natural gas (LNG). Natural gas imports have nearly doubled over the past five years, and Petrobras forecasts that they will continue to rise in the medium term. Most of the additional import volumes will likely come in the form of LNG.



Source: ANP

Imports from Bolivia

Brazil imports natural gas from Bolivia via the Gasbol pipeline, which links Santa Cruz, Bolivia to Porto Alegre, Brazil, via Sao Paulo. The 2,000-mile Gasbol has a maximum capacity of 1.1 Bcf per day (Bcf/d). Gasbol also has a 170-mile, extension that connects to a natural gas-fired power plant in Cuibana, supplying 100 million cubic feet per day (MMcf/d). According to ANP, Brazil imported 395 Bcf of natural gas from Bolivia in 2008, or 99 percent of total natural gas imports.

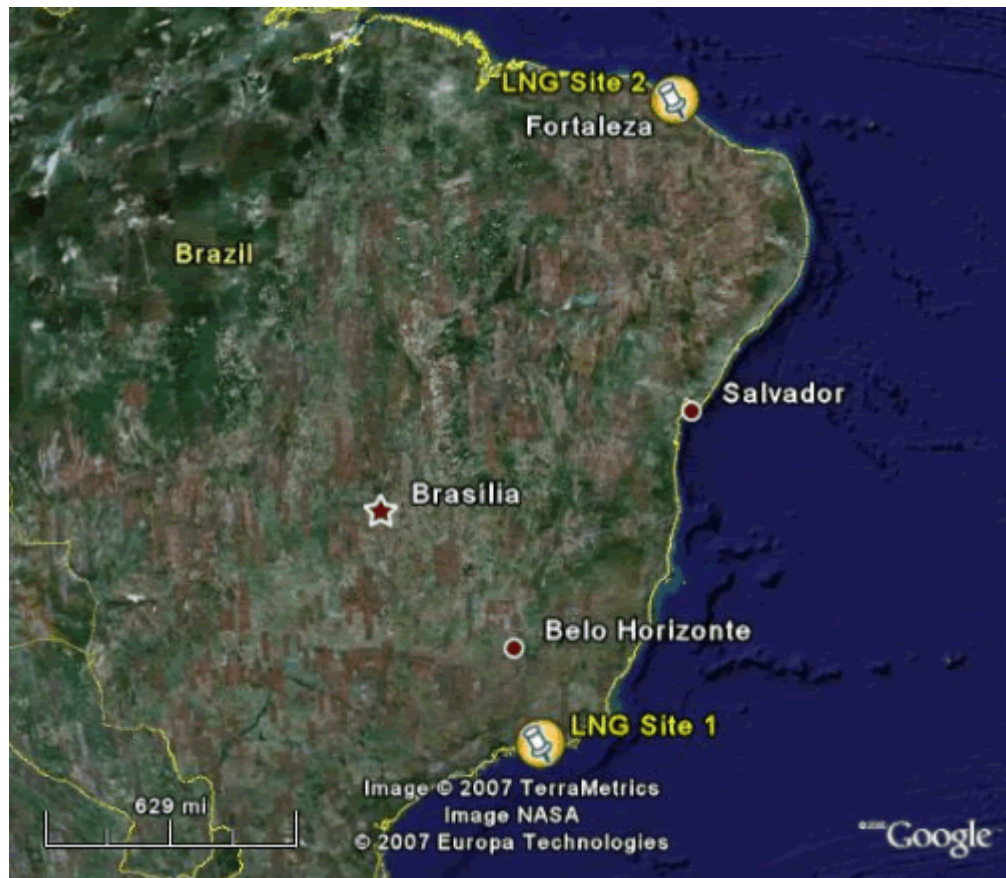
Imports from Argentina

Brazil receives natural gas from Argentina via the Parana-Uruguayana pipeline. The 275-mile, 100-MMcf/d pipeline connects to a gas-fired power plant operated by AES. According to ANP, Brazil imported 4.8 Bcf of natural gas from Argentina in 2008.

Liquefied Natural Gas

Brazil has two liquefied natural gas (LNG) regasification terminals, both installed in the last two years: the Pecem terminal in the northeast, and the Guanabara Bay terminal in the southeast. Both facilities are floating regasification and storage units (FRSU) provided by Golar LNG, with a combined sendout capacity of 740 MMcf/d. The Pecem received its first LNG cargo from Trinidad and Tobago in July 2008, while the Guanabara Bay terminal came online in May 2009. According to ANP, Brazil received 1.3 Bcf of natural gas in the form of LNG in 2008, all of which came from Trinidad and Tobago.

Locations of LNG Regasification Terminals in Brazil

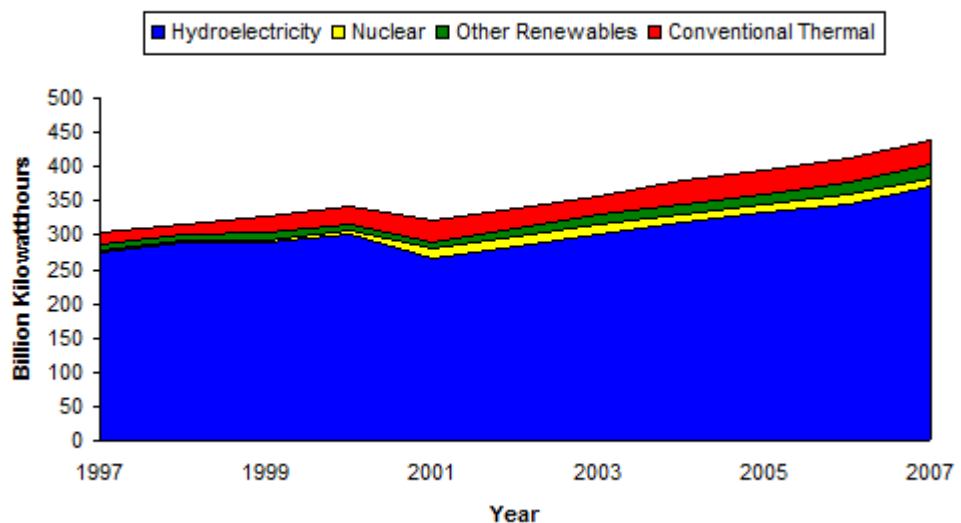


Electricity

Brazil has the third-largest electricity sector in the Western Hemisphere, behind the United States and Canada.

Brazil had 96.6 gigawatts of installed generating capacity in 2007, with the single largest share being hydroelectricity. In 2007, the country generated 437 billion kilowatt-hours (Bkwh) of electric power, while consuming 402 Bkwh. Hydropower provided 85 percent, with smaller amounts coming from conventional thermal, nuclear, and other renewable sources.

Brazil's Electricity Generation, by Source



Source: EIA International Energy Annual

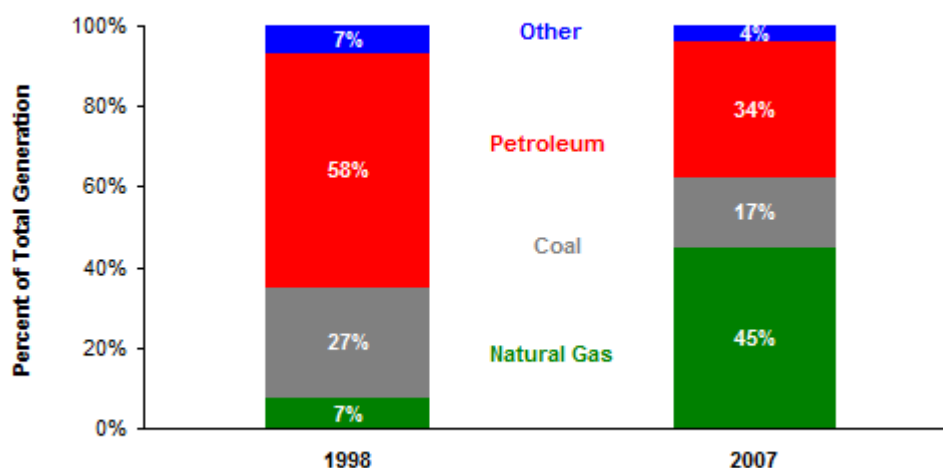
Hydroelectricity

Brazil generated 371 Bkwh of hydroelectric power in 2007, accounting for 85 percent of its total electricity generation. Together with Paraguay, Brazil maintains the Itaipu facility on the Parana River. According to Itaipu Binacional, the facility generated 94.7 Bkwh of electricity in 2008. Many of Brazil's hydropower generating facilities are located far away from the main demand centers, resulting in high transmission and distribution losses. Brazil's heavy reliance on hydroelectricity has caused some issues in the past, especially during periods of below-average rainfall.

Conventional Thermal

Conventional thermal generating sources provided only a small part of Brazil's electricity supply, contributing about 8 percent in 2007. According to Brazil's Ministry of Energy and Mines, the largest contributor to Brazil's conventional thermal power generation in 2007 was natural gas (45 percent), followed by petroleum products (34 percent) and coal (17 percent). The share represented by natural gas has grown sizably in recent years, standing at only 7 percent in 1998.

Brazil's Conventional Thermal Generation, By Type



Source: Ministry of Mines and Energy

Nuclear Power

Brazil has two nuclear power plants, the 630-megawatt (MW) Angra-1 and the 1,350-MW Angra-2. State-owned Eletronuclear, a subsidiary of Eletrobras, operates both plants. Construction of a third plant, the 1,350-MW Angra-3, started in 1986, but was never finished. In 2008, construction began again, with completion slated for 2014. According to industry sources, Eletronuclear plans to build at least four new nuclear power plants (in addition to Angra-3) by 2030, in order to meet expected growth in Brazilian electricity demand.

Profile

Energy Overview

Proven Oil Reserves (January 1, 2009E)	12.6 billion barrels
Oil Production (2008E)	2,396 thousand barrels per day.
Oil Consumption (2008E)	2,520 thousand barrels per day
Crude Oil Distillation Capacity (2009E)	1,908 thousand barrels per day
Proven Natural Gas Reserves (January 1, 2009E)	12.9 trillion cubic feet
Natural Gas Production (2008E)	346 billion cubic feet
Natural Gas Consumption	699 billion cubic feet

(2008E)**Recoverable Coal Reserves (2005E)** 7,791 million short tons**Coal Production (2008E)** 7.6 million short tons**Coal Consumption (2008E)** 27.3 million short tons**Electricity Installed Capacity (2007E)** 96.9 gigawatts**Electricity Production (2007E)** 437 billion kilowatt hours**Electricity Consumption (2007E)** 402 billion kilowatt hours**Total Energy Consumption (2006E)** 9.6 quadrillion Btus***Total Per Capita Energy Consumption (2006E)** 51.2 million Btus**Energy Intensity (2006E)** 6,841 Btu per \$2000-PPP**

Environmental Overview

Energy-Related Carbon Dioxide Emissions (2006E) 377 million metric tons**Per-Capita, Energy-Related Carbon Dioxide Emissions (2006E)** 2.01 metric tons**Carbon Dioxide Intensity (2006E)** 0.49 metric tons per thousand \$2000-PPP**

Oil and Gas Industry

Organization Petrobras: national oil and gas company with partial government ownership, Royal Dutch Shell, Devon, Chevron**Major Oil/Gas Ports** Sao Sebastiao, Paranagua, Salvador, Tramandai, Sao Francisco do Sul, Aracaju, Maceio, Recife, Natal, Fortaleza, Belem**Major Oil and Natural Gas Basins** Campos Basin, Santos Basin**Major Refineries (capacity, bbl/d)** Paulinia-Sao Paulo (350,000), Mataripe-Bahia (293,700), Duque de Caxias-Rio de Janeiro (232,200), Sao Jose dos Campos-Sao Paulo (241,500), Canoas-Rio Grande do Sul (180,900), Araucaria-Parana (180,900), Cubatao-Sao Paulo (162,900), Betim Minas Gerais (144,800)

* The total energy consumption statistic includes petroleum, dry natural gas, coal, net hydro, nuclear, geothermal, solar, wind, wood and waste electric power.

**GDP figures from Global Insight estimates based on purchasing power parity (PPP) exchange rates.

Links

EIA Links

[EIA - Historical Energy Data on Brazil](#)

U.S. Government

[CIA World Factbook - Brazil](#)

[U.S Embassy in Brazil](#)

[U.S. State Department's Consular Information Sheet - Brazil](#)

[U.S. State Department's Background Notes on Brazil](#)

Foreign Government Agencies

[Agência Nacional de Energia Elétrica](#)

[Agência Nacional do Petróleo \(ANP\) \(National Petroleum Agency\)](#)

[Ministério de Minas e Energia \(MME\) \(Ministry of Mines and Energy\)](#)

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Water Power & Dam Construction
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Worldwide Projects
Wood MacKenzie Ltd.
World Gas Intelligence
World Markets Analysis

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